No. 0092-45-82

Freeway Sweeping to Reduce Runoff Pollutants

from research to reality

BRIEF

RESEARCH DEVELOPMENT & TECHNOLOGY TRANSFER

The Wisconsin Department of Transportation (WisDOT) is required to control the quality of storm water runoff from the state highway system as part of the National Pollution Discharge Elimination System and Administrative Rule WDNR 216 on storm water regulations. A Memorandum of Understanding (MOU) between WisDOT and the Wisconsin Department of Natural Resources (WDNR) currently includes highway sweeping after snow melt as a pollution prevention measure. WisDOT would consider more frequent sweeping if it were shown to be an effective method of reducing pollutants in storm water runoff.

What's the Problem?

Highway runoff may be contaminated by heavy metals, inorganic salts, aromatic hydrocarbons or suspended solids that accumulate on the road surface from vehicle operation and from highway maintenance activities such as salting and sanding. Ordinary operation of vehicles results in the dropping of oil, grease, rust, hydrocarbons, rubber particles and other solid materials on the highway surface. Materials may then be washed off the highway by rain or snow, potentially affecting surface or ground water quality. (See FHWA Environmental Technology Brief at www.tfhrc.gov/hnr20/runoff/runoff.htm.)

Adverse effects of highway runoff can be minimized through structural or nonstructural Best Management Practices (BMPs). Structural BMPs operate by physically trapping runoff until contaminants settle out or are filtered through underlying soils or other devices. Nonstructural BMPs include street sweeping, the subject of this research. (WisDOT is examining structural approaches through research in progress, *Evaluation of Storm Water Treatment Technologies for Highway Runoff,* Project No. 0092-00-03. For more information, contact Robert Pearson, robert.pearson@dot.state.wi.us.)

Research Objectives

The primary objective of this project was to determine whether water quality benefits are realized by street sweeping and, if so, to what degree. The study is believed to be the most complete attempt to document the use of a high efficiency sweeper program on an urban freeway section. Secondary objectives were: develop dirt accumulation profiles for freeways in Milwaukee; use the dirt accumulation and water quality data to calibrate the Simple Particulate Transport Model; and characterize the variability in freeway runoff quality. Investigators also hoped to determine whether a relationship exists between traffic count and pollutant concentrations in runoff.

Study Design

The area selected for the project was one of Wisconsin's busiest stretches of interstate highway (daily traffic count of 133,900). The study focused on a 10-acre drainage basin on I-894 just west of Milwaukee. Divided into a test and control basin, the area consists of a six-lane concrete freeway, concrete shoulders, and concrete median dividers.

A high-efficiency street sweeper—the Envirowhirl EV2, manufactured by Schwartz Industries—was used to sweep the outside shoulder of the test area weekly and the inside shoulder biweekly. A mechanical sweeper provided by Milwaukee County alternated sweeping the inside shoulder. Sweeping was conducted over the eleven months of May to December 1999 and January to March 2000. During those months, 35 sweeping operations were conducted, with actual monthly sweeping occurring from 0 to 5 times each month.

Investigators
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The Wisconsin Department of Transportation

Freeway sweeping with a high efficiency sweeper can be a best management practice for the control of pollutants in storm water runoff.

Buffer areas were established between the test and control areas to prevent vehicles from "pulling" dirt into either basin. Runoff from each basin is currently directed into a storm water collection system that flows into the Milwaukee Metropolitan Sewerage District system. Data collected included: street dirt from the outside shoulders, dirt collected by the high-efficiency sweeper, continuous precipitation data, storm water flow, storm water runoff, median runoff, and traffic counts.

Study Results

- Comparison of the total suspended sediment levels in the test and control section runoff indicated a reduction due to the weekly sweeping. While investigators were only able to quantify the reduction within a broad range, the data indicated that a once-per-week sweeping program could be an effective storm water runoff BMP for urban freeways.

- Results also indicate that pavement sweeping in the test section reduced highway dirt loading during seven of the nine sweeping events. At the control site, where no sweeping occurred, the pavement dirt load increased during the time of six of the nine sweeping events in the test section.

- Operational issues with the sweeper suggest the need for considering the use of other models in the future. Some of these issues included the travel speed of the unit (12 miles per hour), the need for a following traffic control vehicle, insufficient pickup on uneven surfaces, and the lack of flexibility of the gutter brush.

"This study was made possible through close cooperation between WisDOT, WDNR, the Milwaukee County Department of Public Works, the State Lab of Hygiene and the US Geological Survey."

- Tom Martinelli, WisDOT Regional Maintenance Engineer

Further Research and Implementation

Additional research is being proposed to more fully explore the primary objective of this study, which was to determine whether street sweeping would have a beneficial effect on storm water runoff characteristics. Additional information needs to be obtained to re-address objectives of this study. Activities may include sampling additional storm water runoff and highway dirt, analyzing the effect of median materials and potential median maintenance improvements, conducting computer storm water modeling and simulations, and performing cost-benefit analyses.

WisDOT will use the research results to develop statewide Maintenance Manual guidelines for a freeway sweeping program, addressing such issues as required equipment, sweeping frequency and other details. WisDOT will also develop a training program for county highway departments and WisDOT District Highway Operations personnel affected by new Maintenance Manual guidelines.

Research results will be shared with WDNR, for inclusion as a BMP in its "Green Book" on storm water management. Together with WDNR, WisDOT will modify the current MOU on storm water discharge to include specific language on freeway sweeping as a BMP.

Benefits

Results of this study indicate that street sweeping may be an appropriate BMP that could achieve substantial reductions in storm water runoff pollution. This will ultimately reduce pollutant loadings to surface and ground water, assist municipal treatment facilities in meeting terms of their discharge permits under the Clean Water Act, and minimize the use of vital urban land parcels for structural BMPs.

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Pollutant Loadings to Stormwater Run-Off from HIghways: The Impact of a Sweeping Program

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For more information

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